

SOCIAL EVALUATIONS OF 7- AND 8-MONTH-OLD INFANTS

A Thesis

by

TYLER JOSHUA KASPERBAUER

Submitted to the Office of Graduate Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

May 2012

Major Subject: Psychology

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ABSTRACT

Social Evaluations of 7- and 8-Month-Old Infants. (May 2012)

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A landmark experiment by Kiley Hamlin, Karen Wynn, and Paul Bloom demonstrated that infants as young as 6 months old possess previously unrecognized abilities to form social evaluations. In the experiment, infants were shown a shape that was made to appear as if it was climbing a hill. In one event, another shape helped the climber up the hill, while in a separate event, a different shape prevented the climber from reaching the top. When offered a choice between the helping and hindering shapes, both 6- and 10-month-olds chose the helping shape over the hindering shape, showing that they had evaluated the actions and preferred the helper as a result. In an additional test, the climber was made to appear as if it was “choosing” the helping shape or the hindering shape. Infant looking times were measured in order to assess which “choice” was more surprising. Interestingly, the 6-month-olds looked equally for both events, while the 10-month-olds looked longer when the hinderer was approached. This demonstrated that the 10-month-olds were attributing preferences to the climber, and expected that the climber would prefer the helper just as they had. This ability was apparently beyond that of the 6-month-olds, but no assessment or explanation has been

offered for why this would be. The current study attempted to remedy this problem by replicating this experiment with 7- and 8-month-olds.

The 7-month-olds in this experiment performed as expected, preferring the helper over the hinderer. The 8-month-olds, however, showed no clear preference. This was unexpected and not easily explainable. Neither age showed a difference in looking time whether the climber approached the helper or the hinderer. These looking time data suggest that 7- and 8-month-olds are closer to 6-month-olds in their ability to attribute evaluations to other agents, indicating that these abilities do not develop until later infancy, around 9 or 10 months. However, lack of significant results on the looking time test need not indicate a lack of social knowledge, and may instead stem more directly from developing theory of mind abilities. Options for future studies pitting social knowledge against theory of mind are explored.

TABLE OF CONTENTS

	Page
ABSTRACT	iii
TABLE OF CONTENTS	v
1. INTRODUCTION.....	1
Determinants of Social Evaluation.....	3
Social Evaluation.....	7
Familiarity and Novelty	13
2. METHODS.....	16
Participants	16
Apparatus and Stimuli	16
Events	17
3. RESULTS.....	20
Choice Test.....	20
Looking Time Test	21
4. DISCUSSION AND CONCLUSION.....	23
Explaining Unexpected Results	23
Infants' Understanding of Other Minds	26
Conclusion.....	32
REFERENCES.....	33
VITA	40

1. INTRODUCTION

In recent experiments on social evaluations, infants as young as 6-months-old have been shown to prefer “helping” shapes over “hindering” shapes (Hamlin, Wynn, & Bloom, 2007; Hamlin, Wynn, & Bloom, 2010; Kuhlmeier, Wynn, & Bloom, 2003; Wynn, 2008). In these experiments, infants are habituated to repeated sequences of a circle attempting to climb a hill, followed either by a square thwarting its efforts by pushing the circle down the hill or a triangle providing assistance by pushing the circle up the hill. The main results of Hamlin et al. (2007) showed that 6- and 10-month-olds, when given a choice between the helper and the hinderer, preferred the helping shape. An interesting age difference was found, however, in a looking time task. When the climbing shape, in a non-climbing setting, approached the hinderer instead of the helper, 10-month-olds *looked longer* than when the shape approached the helper. This indicated that the 10-month-olds expected the climbing shape to have formed a preference for the helping agent, just as they had, and to act accordingly. The 6-month-olds, by contrast, did not show a difference in looking time, indicating that the actions of the climbing agent were not surprising to them. This is puzzling, as the 6-month-olds formed a preference for the helper just as the 10-month-olds had. Why would this be? Why would 6- and 10-month-olds form divergent expectations of the climbing agent?

The current study attempts to answer these questions by assessing the response of 7- and 8-month-olds to the social evaluation task from Hamlin et al. (2007). Variations

This thesis follows the style of *Developmental Psychology*.

on Hamlin et al.'s (2007) methodology have been conducted with 3- and 4-month-olds (Hamlin, Wynn, & Bloom, 2010), 5- and 12-month-olds (Kuhlmeier, Wynn, & Bloom, 2003) and 9- and 12-month-olds (Wynn, 2008), but never 7- and 8-month-olds. These other experiments have all consistently found an age difference between the choice test and the looking time test. Wynn (2008) furthermore reports that 9-month-olds express looking times similar to that of the 10-month-olds in Hamlin et al. (2007). So although it is clear that at least by 6 months infants prefer the helper to the hinderer on the choice test, it has not yet been determined at what time between 6 months and 9 months that infants begin to shift in the type of understanding measured by the looking time test.

The evaluations infants display in these experiments require sophisticated social knowledge previously unacknowledged in infants this young. This knowledge does not arise *ex nihilo*, however, and in fact relies upon many other psychological processes that develop throughout the first year of life. The first part of the introduction will outline other processes that determine social evaluations, such as the attribution of goals, intentions, and dispositions. These allow infants to understand how even basic shapes can be goal-oriented and act intentionally. This discussion will be followed by a more detailed analysis of social evaluation experiments and the development of moral psychology in infancy. Finally, a few words will be said about the role of novelty and familiarity in these experiments. Since the looking time task is key to explaining age differences in social evaluations, it is crucial that the results can be interpreted according to *either* a novelty effect *or* a familiarity effect. The violation of an expectation can

result from either. This debate must be adjudicated in order to determine the cause of age differences in social evaluations.

Determinants of Social Evaluation

Even in their first year, human infants possess the ability to attribute intentions and action preferences to agents other than themselves. For instance, 5- and 6-month-olds who see a human hand consistently reach for one of two objects (e.g., a bear and not a ball) expect that it will continue to reach for that same object (Woodward, 1998). Even if the ball and bear switch locations, infants still expect the hand to reach for the bear. This expectation does not arise, however, if the hand appears to engage the ball accidentally (Woodward, 1999, 2009). Infants as young as 3 months old will make similar attributions to even basic shapes when the shapes are made to appear autonomous and self-propelled. Infants who see an otherwise novel inanimate object move towards another object expect that this action tendency will persist across many different situations (Luo, 2010; as will 5-month-olds, Luo & Baillargeon, 2005; and 12-month-olds, Shimizu & Johnson, 2004).

This assumption that action tendencies will remain consistent indicates that infants attribute *dispositions* to both objects and agents. Nine-and-a-half-month-olds, for example, will readily detect when somebody plays with toys in one particular way; say, by only sliding toy trucks on the ground. They then show surprise when that same person makes it impossible to persist in that style of play by selecting trucks that are not able to slide (Song & Baillargeon, 2007). This provides an important strategy for identifying objects: attributing dispositions allows infants to tie behaviors to objects such

that those behaviors identify what that object is and what it does. It furthermore allows infants to assume that other agents possess an understanding of how objects function and will use them appropriately.

This latter observation suggests that infants possess standards by which they judge other agents. A consistent finding in research on this topic is that infants assume that goals will be achieved with a certain degree of efficiency: 12-month-olds, for example, will attribute goals to animated shapes, and show surprise if those shapes try to reach goals by inefficient means (e.g., traveling in a curved line when a straight line would be faster) (Gergely, Nadasdy, Csibra, & Biro, 1995). Infants make note not only of the shape's goal but also what would be the best strategy for achieving that goal. In an experiment by Hamlin, Newman, and Wynn (2009), 8-month-olds were shown a scene in which an adult performed actions with a ring and a cone, but evidence of the adult's goal was ambiguous. They found that infants attempted to complete the task, assuming that the adult intended to place the ring on the cone. In both of these experiments infants attributed goals with very specific content that went beyond the evidence provided.

The standards infants use in their goal attributions occasionally result in social evaluations. Behne, Carpenter, Call, and Tomasello (2005) demonstrated that 9-, 12-, and 18-month-olds (but not 6-month-olds) show more frustration when a toy is intentionally kept from them than when they are accidentally not given a toy (Marsh, Stavropoulos, Nienhuis, & Legerstee, 2010 observed frustration behaviors in 6-month-olds as well, using more sensitive measures of frustration). Hart and Carrington (2002) found that 6-month-old infants show more jealousy when their caretakers respond

preferentially to a toy doll than when they respond preferentially toward a book. These experiments show that infants expect adults to treat them in a certain way, and get upset when adults do something they dislike. Thinking of these transgressions in relation to adults, we might say that someone making an intentional refusal is being mean. We are also more likely to become jealous over human competitors (or in this case a doll) than something inanimate. It appears that infants make similar judgments. Their ability to attribute goals to other agents allows them to recognize when someone possesses the intention to frustrate their own goals. In these experiments, this is expressed in the form of frustration and jealousy, but we might wonder how else this behavior could be characterized.

Researchers working on socio-emotional development in infancy have noted the tendency for infants to be more sensitive to negative information than positive information. Frustrated goals and jealousy are just a couple examples. This “negativity bias” in early development (Carver & Vaccaro, 2007; Vaish, Grossman, & Woodward, 2008) can be seen in a variety of other studies, perhaps most notably in one of the first experiments on social evaluations. Premack and Premack (1997) claimed that negative information is highly significant for infants, but further reasoned that this hypersensitivity to negative information should express itself with respect to positive information as well. For example, if infants view a goal as being bad in some way, presumably that entails that other goals are more positive. In their experiment, Premack and Premack, showed 13-month-olds animated events in which shapes either appeared to help other shapes achieve their goals (helping them move to parts of the display) or

hinder their goals (prohibiting them from moving to parts of the display). If infants saw the helper event followed by the hindering event, they showed surprise at the hindering event. The opposite effect was not observed, however; seeing the hindering event followed by the helper event failed to produce surprise to the helper event. This demonstrated that the helping event was thoroughly expected, while the hindering event was not. This supports the idea that negative information is more salient, apparently in virtue of infants' assumption that helping behavior is expected. A weakness of this experiment, however, is that it remains difficult to see how infants are differentiating the value of the two events. It's not clear, that is, whether increased surprise indicates that one action is seen as *more positive* than the other, or if instead violating expectations should be interpreted in a more minimal way. This is the problem space within which recent experiments on social evaluations have been conducted.

One objection that might be raised is that low-level evaluations, such as that studied by Premack and Premack, will be unable to provide insights into moral development (Jacob & Dupoux, 2008). Social evaluation abilities that develop in the first year are of course precursors to full-fledged adult morality, but it has traditionally been thought that the most interesting moral behaviors do not develop until later in infancy. For instance, a marked increase in "prosocial" behaviors (showing concern and offering assistance to others) is observed after the first year (Dunn, 1987), with a dramatic increase in such behaviors throughout the second year (Zahn-Waxler, Radke-Yarrow, Wagner, & Chapman, 1992). The argument could be made that the behaviors of

young infants are too different from that seen in the second year to provide insights into the development of morality.

In response, what experiments on infants in the first year can provide is an insight into how the attribution of goals, preferences, and dispositions are related to broader social evaluations. Infants may not be able to act prosocially, but they can show a preference for prosocial agents. They can understand when agents are frustrating their own goals, and, as Premack and Premack showed, evince surprise when agents frustrate others' goals. Infants' identification of whom they like and whom they think other people like is a significant component of early development (Platten, Hernik, Fonagy, & Pasco Fearon, 2010). As discussed in the next section, recent experiments have allowed researchers to expand upon the designs of Premack and Premack, as well as others, in order to test more precise questions about infants' social knowledge in the first year of life.

Social Evaluation

This section will briefly re-describe the original Hamlin et al. (2007) experiment in addition to discussing other experiments relevant to properly replicating and interpreting Hamlin et al. (2007). One early study of social evaluations that used potentially problematic methods of assessment (Kuhlmeier et al., 2003) will be discussed separately. This experiment, as well as a couple of others (Hamlin, Wynn, & Bloom, 2010; Wynn, 2008), have used assessment measures that are slightly incommensurate with Hamlin et al. (2007) and require explanation apart from the general methodology of this replication.

As described previously, the central task of Hamlin et al. (2007) consisted of a climbing event in which infants viewed one shape attempt to climb a hill. Infants then watched other shapes enter the scene in alternating trials, one that was ostensibly trying to help the shape complete its goal (to get to the top of the hill) and the other trying to prevent it from reaching its goal. Two different tests followed these climbing trials. One was a looking time measure, in which the climbing agent was shown in between the other two shapes and “chose” one by moving closer to it. This was intended to measure whether the infants attribute preferences to the circle and whether the circle’s actions surprised them. The second test was a choice task, in which the helper and hinderer shapes were presented to the infants side-by-side and the infants were given the chance to pick one. Six- and 10-month-olds diverged in their performance on the two tests. Although both 6- and 10-month-olds preferred the helper in the choice task, only 10-month-olds showed evidence of surprise (measured by looking time) when the circle “chose” the hinderer. The 6-month-olds, that is, looked equally whether the circle approached the helper or the hinderer.

A couple details are important here. Multiple controls were included in this landmark experiment, the effectiveness of which serves to reduce the need to include them in the current study. First, other choice tests independently paired the helping and hindering agents with a neutral shape—one that climbed up and down the hill but did not interact with any other shape. Results showed that infants preferred the helper to the neutral agent and the neutral shape to the hinderer. This is crucial, as it demonstrates that the hinderer is in fact considered something to be avoided, not just that it is worse than

the helper. A second important detail is that a separate condition used the same events but a climber without eyes or self-propulsion. Eyes and self-propulsion are *agency cues*, or features that indicate that something is an agent and is capable of possessing goals. In this condition, infants did not show a preference for either the helper or the hinderer. This demonstrates that the agency cues are essential for the infants in attributing specific goals—that of helping and hindering—to otherwise normal shapes. That these were the only cues required to observe an effect is significant, as 6-month-olds generally need multiple cues in order to attribute goals (Biro & Leslie, 2007).

The basic methodology of Hamlin et al. (2007) has been replicated with infants as young as 3 months old. Due to their lack of motor skills, all test events with infants this young relied upon looking times instead of choices. Hamlin, Wynn, and Bloom (2010) showed 3-month-olds the exact same climbing events from Hamlin et al. (2007), followed by the same presentation of the helping and hindering agents. Instead of asking the infants to choose one, the researchers instead measured the amount of time spent looking at each agent. They found that the 3-month-olds looked longer at the helper, which they took to indicate that the infants preferred the helper. They also paired the helper and hinderer with a neutral agent in a separate choice task. The neutral agent either moved up or down the hill without making contact with the climber. This was meant to study whether the infants' evaluations represented something more than a comparative preference for the helper (as in Hamlin et al., 2007). They found that 3-month-olds looked longer at the helper than the neutral character, and longer at the

neutral character than at the hinderer. This demonstrated that the infants not only liked the helper, but that they also disliked the hinderer.

Hamlin and Wynn (2011) conceptually replicated Hamlin et al.'s (2007) experiment, using different stimuli and events, with 5- and 9-month-olds. They first familiarized infants to a scene in which a puppet dog attempted but failed to open a box. Infants then saw one of two scenes: they either watched as another puppet entered the scene and opened the box all the way, or they saw a different puppet enter and jump on top of the box to slam it shut. Infants were then given a choice test similar to that used in the original climbing experiments (except these were of course puppets). Twenty-five of 34 infants chose the helper over the hinderer, including 13 of 18 5-month-olds. Interestingly, in an inanimate condition, where the puppets were replaced by pincers, this preference was reversed. Though the results didn't reach significance, 23 of 34 infants chose the hinderer over the helper, including 12 of 18 5-month-olds and 11 of 16 9-month-olds. These pincer results are mentioned only because it is curious that infants appear to be capable of attributing goals to (and subsequently making social evaluations of) plain shapes, but have more difficulty with plain pincers. This highlights the importance of the agency cues discussed previously.

In a second experiment, Hamlin and Wynn (2011) showed 5-month-olds a similar scene, but this time a puppet cat was playing with a ball. Again either a helper or hinderer entered the scene. In both the helper and hinderer conditions the original puppet would roll the ball to the newcomer, then the newcomer would either roll the ball back (helping condition) or take the ball and run out of the screen (hindering condition).

Again, there was a clear preference for the helper in the puppet condition (10 of 12 preferring the helper) and less of a preference in the pincer condition (4 of 12 preferring the helper).

The experiments described thus far from Hamlin and her colleagues demonstrate that a preference for helpers over hinderers exists as young as 3 months of age. Hamlin and Wynn (2011) furthermore show that this preference is observed across a variety of situations, not just the original climbing events. What these experiments have not addressed, however, is the age difference observed in Hamlin et al. (2007). That is, these experiments corroborate the finding that infants make basic evaluations of “helper” and “hinderer,” but they do not investigate whether infants expect others to possess similar evaluations.

Hamlin, Wynn, Bloom, and Mahajan (2011) attempted to address this question by altering the methods of Hamlin and Wynn (2011). First, they presented 5- and 8-month-olds with the exact same box-opening events from the first experiment of Hamlin and Wynn (2011): a puppet was either assisted or thwarted by another puppet in trying to open a box. Then, instead of being presented with a choice task, the infants were shown the ball-rolling events from the second experiment of Hamlin and Wynn (2011). The important difference, however, was that the helpers and hinderers from the box-opening events were featured as the ball-players. In one condition, new puppets entered and either stole the ball or returned it to the *helper*. In the other condition, new puppets entered and either stole the ball or returned it to the *hinderer*. Using the helper and hinderer in both events allowed the infants to evaluate other agents’ reactions to the

helper and hinder. The infants were then given a choice test between the Giver and the Taker from the ball-rolling events. When the infants saw helping events, they preferred the Giver, or the agent who had helped the helper (12 out of 16 5-month-olds and 12 out of 16 8-month-olds). When the infants saw hindering events, however, an age difference appeared. 8-month-olds preferred the Taker (14 of 16), or the agent who hindered the hinderer, while the 5-month-olds preferred the Giver (13 of 16). It appears, that is, that the 5-month-olds were only evaluating the specific action (whether it was a helping or hindering act), while the 8-month-olds took into account *who* was being helped or hindered. As Hamlin et al. (2011) describe the difference in understanding between 5- and 8-month-olds, “the value of a social act is not determined solely by its positive or negative effect upon a recipient, but also on that recipient’s own status as a positive or negative individual” (p. 19932).

These latter results offer a reason to think that a shift in social evaluations takes place some time around 8 months. The 8-month-olds in Hamlin et al. (2011) made an evaluation of specific acts (helping and hindering), attributed that evaluation to a disposition inherent in specific agents (the helper and the hinderer), and used this information to form a preference for agents who helped helpers and hindered hinderers. 8-month-olds who are capable of making this level of social evaluations are presumably also capable of performance similar to that of the 9- and 10-month-olds on the looking time tasks from Hamlin et al. (2007). Hamlin et al.’s (2011) results demonstrate that infants prefer agents who share their perspective (i.e., who help the agents they like and hinder the agents they don’t like). This sort of perspective explains the looking time

results from Hamlin et al. (2007): from at least 9 months of age, infants expect other entities to form social evaluations similar to their own. When other agents fail to act in accordance with their presumed evaluations, infants are surprised. The current experiment will assess whether Hamlin et al.'s (2011) results with 8-month-olds are indeed applicable to the age differences observed in Hamlin et al. (2007).

Familiarity and Novelty

This section will provide a brief justification of looking time tests within Hamlin et al.'s (2007) methodology. The main concern stems from computerized versions of the climbing events. Wynn (2008) reports an experiment in which 9- and 12-month-olds viewed a computerized version of the climbing task, followed by a looking time task in which no hill was present. Consistent with Hamlin et al. (2007), both 9- and 12-month-olds looked longer when the climber approached the hinderer than when it approached the helper. However, an earlier computerized version with 5- and 12-month-olds found exactly the opposite (Kuhlmeier et al., 2003). Twelve-month-olds looked longer when the climber approached the *helper* than when it approached the *hinderer* (5-month-olds showed no difference). This makes the results difficult to interpret. Kuhlmeier et al. (2003) explain their results in terms of a preference for the climber to approach the helper while Wynn (2008) reports that longer looking times indicate a violation of expectation. This latter interpretation has been favored in all subsequent experiments (including Hamlin et al., 2007).

Wynn (2008, p. 341) suggests that the difference in results on the looking time task was due to the addition of facial features (eyes) to the shapes; the experiment

described in Wynn (2008) used facial features, but Kuhlmeier et al. (2003) did not.

Wynn reasons that the differential results on the looking time test indicates a difference in stimuli complexity (and thereby event complexity). Experiments that utilize a violation-of-expectation methodology rely upon a well-known distinction in the way infants respond to novelty and familiarity: infants respond more to familiarity when presented with complex or unfamiliar events, and respond more to novelty when presented with familiar or simple events (Hunter and Ames, 1988; Hunter, Ames, and Koopman, 1983; Moore & Johnson, 2011; Oakes, 2010). Infants looked longer when the climber approached the *helper* in Kuhlmeier et al. (2003) because the lack of faces elicited a preference for familiarity. Infants looked longer when the climber approached the *hinderer* in the experiment reported by Wynn because the presence of faces allowed the infants to respond to other aspects of the event—namely, the novelty of the climber approaching the hinderer.

Though one might wonder whether this adequately explains the observed results, the more important question for the current replication is whether the basic idea justifies Hamlin et al.'s (2007) looking time measure. Hamlin et al.'s (2007) looking time task is different from that of the computerized versions in that the shapes are presented on a shallow hill. The climber thus “chooses” one of the shapes against a background similar to that of the climbing trials the infants are already familiar with. According to the distinction between novelty and familiarity described above, infants should find these events highly familiar, and thus be more sensitive to novelty. If infants are truly attributing preferences to the climbing shape, this task should be able to detect such

attributions. Other agency cues that serve to enhance familiarity, besides eyes, are also present in Hamlin et al.'s (2007) task. As will be described in more detail below, the climber is made to move in such a way that its "choices" appear more intentional.

2. METHODS

The methods of this experiment were intended to be an exact replication of Hamlin et al. (2007). The shapes were of slightly different color and shape, and other small modifications were made to accommodate a different testing space, but otherwise all stimuli and events were identical. Hamlin et al.'s (2007) results create very few specific predictions for the performance of 7- and 8-month-olds. It is expected that both ages will show a preference for the helper over the hinderer, but there is no reason to form specific predictions for either age on the looking time task.

Participants

Thirty infants were recruited for this experiment. The data from three infants were excluded due to experimental error. One other infant was excluded because of lack of habituation and looking times (explained below) more than three standard deviations from the mean. This left 11 7-month-olds and 15 8-month-olds (10 females and 16 males). 7-month olds ranged from 6 months, 20 days to 7 months, 15 days. 8-month-olds ranged from 7 months, 23 days to 8 months, 26 days. No randomization was needed as all infants were included in every condition and presentation of trials within each condition was counterbalanced.

Apparatus and Stimuli

For all trials, infants sat on their parent's lap facing a wooden cubicle 213 cm high, 105 cm wide and 43.5 cm deep. The wooden cubicle had an opening 51 cm high and 93 cm wide in its front wall. The infant's head was approximately 78 cm from the objects on the platform. The floor and the walls of the apparatus were covered with

lightly-patterned contact paper. A muslin-covered shade in the front wall of the apparatus was raised to signal the beginning of each trial and lowered at the end of each trial, remaining lowered until the beginning of the next trial. To illuminate the stage, four 20-watt fluorescent bulbs were affixed inside each wall of the apparatus.

The display for the familiarization trials was a light pink background with a green hill protruding 10 cm. The hill rose from the lower right to the upper left corner of the display (41 cm at its highest point). It had a small plateau one-third of the way up and a second at the top. There were openings at the top and at the bottom of the hill for the characters to enter the display. The characters were wooden blocks with “googly eyes” attached to one side and a wooden rod attached to the other (for experimenter handling). The circle was 10 cm in diameter and always blue. The square was 9 cm by 6.5 cm and always purple. The longest side of the triangle was 15 cm, with each of the two other sides 7.5 cm, and was always yellow. The shapes were made to appear of roughly equal size when placed next to each other against the background.

The display for the looking time test contained a shallow symmetrical test hill (75 cm long, rising 15 cm from lowest to highest point; light pink background as in familiarization trials). The hill was green and the background light pink, just as in the familiarization trials. An all-white piece of foamboard was used for the choice test.

Events

All infants were first presented with an event in which a circle was either helped up (by a triangle or square) or pushed down a hill (by whichever shape was not the helper). Each shape was a different color that remained constant across trials. The events

occurred repeatedly until the infant looked away for 2 consecutive seconds. The maximum time for each trial was 60 seconds, with each event taking 12 seconds.

Whichever event was not shown in the first trial (helper or hinderer) was presented in the second trial, following the exact same procedure. This order was counterbalanced across six trials such that every infant saw three helper and three hinder trials (six trials total).

The time each infant spent watching the scene was recorded by two observers.

Following the helper and hinderer climbing trials was either the choice test or the looking time test (order counterbalanced across all participants). For the looking time test, the circle (the climbing agent) sat at the top center of the hill, with the helper and hinderer shapes 15 cm away on the bottom right and bottom left. The climber moved back and forth (10 cm each way) along the crest of the hill twice, then swayed side-to-side for 2 seconds at the top center. The climber partially approached, retreated, and then fully approached to rest next to the helper or hinderer (on alternating trials). Infants' looking time to the now-stationary characters was then recorded by two observers. Trials ended when the infants looked away for 2 consecutive seconds.

For the choice test, an experimenter entered behind the apparatus and presented the helper and hinderer to the infant on a piece of white foamboard. The helper and hinderer were placed 50 cm apart. The experimenter encouraged the infant by asking, "Do you want to pick one?" which marked the beginning of the trial. A choice was determined by either intentionally touching or picking up the shape. Infants were given 20 seconds to make a choice. The infants received four choice trials. The infant's choice

was recorded, as was the amount of time they took to make their choice (latency to choose). The trial was ended once the infant made a choice.

3. RESULTS

The average looking time on the familiarization trials was nearly equal for each age group (7-month-olds: $M = 43.38s$, $SD = 9.32$; 8-month-olds: $M = 42.50s$, $SD = 12.07$; $t(24) = .04$, $p = .843$). Difference in looking time on the final trial of the familiarization events also failed to reach significance (7-month-olds: $M = 27.56$, $SD = 12.30$; 8-month-olds: $M = 26.83s$, $SD = 18.37$; $t(24) = .013$, $p = .911$).

Choice Test

The choice data were analyzed with a binomial probability test, following Hamlin et al. (2007). Only the infants' first choice was analyzed, again following Hamlin et al. (2007). So, for example, if an infant failed to make a choice on the first trial, chose the hinderer on the second trial, and then chose the helper on the third and fourth trials, only the choice of the hinderer from the second trial was included in the analysis. The 7-month-olds displayed choice behavior similar to that of the 6-month-olds in Hamlin et al. (2007), with 11 of 11 7-month-olds choosing the helper ($p < .001$, one-tailed). Curiously, the 8-month-olds did not show a clear preference for either agent, with 8 of 15 8-month-olds choosing the helper ($p = .500$). Notwithstanding the 8-month-old data, overall preference for the helper did reach significance (19 of 26 infants, $p = .015$).

No effect was found for gender, order of presentation in the familiarization trials, or order of tests. No side or shape preference was observed either.

Consistent choice for each age was also calculated, in order to explore further differences that might explain the 8-month-old choice data. Seven of 9 7-month-olds

chose the same agent twice in a row (two infants made only one choice total; $p = .09$). Among 8-month-olds, only 3 of 12 infants chose the same agent twice in a row (three infants made only one choice total; $p = 0.073$). Although neither of these quite reached significance, the relative difference in consistency between 7- and 8-month-olds might suggest an age difference in the way the task was processed. Potential implications for this will be explored in more detail below.

Latency to choose, or the time infants took to make a choice, was analyzed with an independent samples t -test. Latency as a function of age was nearly equal (7-month-olds: $M = 8.33s$, $SD = 6.05$; 8-month-olds: $M = 8.69s$, $SD = 6.73$; $t(23) = -.14$, $p = .891$). Latency as a function of choice showed more differentiation, but still did not reach significance (Choose Helper: $M = 9.24s$, $SD = 6.60$; Choose Hinderer: $M = 6.29s$, $SD = 5.12$; $t(23) = .99$, $p = .328$).

Looking Time Test

Following Hamlin et al. (2007), the difference in looking times was analyzed with a paired samples t -test for each age group. Four infants did not receive the looking time test and were of course not included in the analysis. One other infant was excluded because of experimental error.

The mean looking times for 7- and 8-month olds were more similar to Hamlin et al.'s (2007) 6-month-olds than that of the 10-month-olds, with nearly equal looking times to the helper and the hinderer (7-month-olds: Helper $M = 16.63s$, $SD = 11.12$; Hinderer $M = 17.78s$, $SD = 8.80$; $t(9) = -.34$, $p = .75$; 8-month-olds: Helper $M = 11.72s$, $SD = 4.26$; Hinderer $M = 10.32s$, $SD = 6.88$; $t(10) = .72$, $p = .49$). It is notable that the 7-

month-olds looked longer at both stimuli, on average, than the 8-month-olds, though only the difference when approaching the hinderer reached significance $t(19) = 1.362, p = .042$).

A 2 X 2 X 2 analysis of variance (ANOVA) was conducted on the order of familiarization trials (helper first or hinderer first), order of test trials (looking time or choice), and order of approach (helper or hinderer), with performance on each approach of the looking time test as a within-subjects factor. No significant interactions were found.

4. DISCUSSION AND CONCLUSION

This replication provides answers to some of the questions raised by Hamlin et al. (2007) but also creates a few questions of its own. The 7-month-olds' preference for the helper was consistent with that found with 6- and 10-month-olds in Hamlin et al. (2007) and 9-month-olds in Wynn (2008). Curiously, no such preference was found with 8-month-olds. In fact, 8-month-olds didn't show a clear preference in either direction. The first place to look for an explanation for this would be the looking time test, but the results of the looking time test showed that both ages looked equally whether the climber approached the helper or the hinderer. Had 8-month-olds shown a preference for the helper, the only possible conclusion would be that social evaluations are stable from 6 to 9 months, but that infants begin to develop a new ability—one related to attributing evaluations to other agents—around the 9-month landmark. This experiment does support the importance of the 9-month landmark, but the peculiar response of 8-month-olds creates difficulties for explaining the development of social evaluations from 6 months on.

Explaining Unexpected Results

One possible explanation for the 8-month-olds' choice data is that there are relevant differences in stimuli complexity between this experiment and Hamlin et al. (2007) that prevented the 8-month-olds, but not the 7-month-olds, from forming evaluations. These differences, depending on what they might be, could perhaps prevent infants from perceiving the agents' actions as even minimally goal-directed. Indeed, as explained earlier, experiments in this line of research have found that stimuli complexity

can determine whether approaching the helper is seen as a novel event or familiar event, and thus can modify looking times. If a difference in stimuli complexity could be found in this experiment, the aberrant 8-month-old data from the choice test could perhaps be explained along similar lines.

This explanation seems unlikely, however, for a number of reasons. For one, there is no reason to think that 7-month-olds would be less sensitive than 8-month-olds to any relevant differences. There is no theoretical reason to support an age-difference in processing stimuli complexity that applies to 6-, 7-, 9-, and 10-month-olds, but not 8-month olds. Furthermore, other experiments that have found age-differences pertaining to stimuli complexity have placed these differences at younger ages, between 3 and 5 months (Moore and Johnson, 2011). Finally, unlike the infants reported by Wynn (2008), who showed an unexpected preference for the hinderer, the infants in this experiment showed *no* preference. This makes potential differences in stimuli explanatorily unhelpful.

The difference in choice consistency between 7- and 8-month-olds might be taken to support the idea that the difference in choice preferences reflects a difference in event processing. The 7-month-olds, all of whom chose the helper, were more likely to choose the helper twice in a row. By contrast, the 8-month-olds, who didn't show a strong preference for either the helper or hinderer, were more likely to switch their preferences on their second choice. These differences failed to reach significance, however, so it remains difficult to interpret these findings.

The fact that 7-month-olds looked longer at both shapes on the looking time test than the 8-month-olds could also be taken to suggest an age difference in event processing. An obstacle here is that no differences were found in the familiarization events. Both ages looked equally during the climbing events, suggesting that they processed the events similarly. This excludes the possibility that it was something about the apparatus or shapes that could have been more difficult for one age group than the other. Perhaps there was something about the looking time events that was processed differently according to age, but there's no reason to think that this impacted the choice test.

Both of these last two proposals rely on the conjecture that there was some nuance of the experimental procedure that was overlooked by 7-month-olds but led to confusion among 8-month-olds. It's not clear what this might be, however, or why only 8-month-olds would be affected. Of course it may still be the case that an accumulation of small differences between this experiment and Hamlin et al. (2007) influenced processing, and perhaps the small number of participants is hiding the fact that 7-month-olds were just as confused as the 8-month-olds. With further testing, perhaps the 7-month-olds and 8-month-olds would begin to show more compatible preferences. This is certainly a possibility, but the current evidence makes it difficult to say whether this is likely or not.

Finally, these results could be taken as evidence for a U-shaped trajectory in social development (Rakison & Yermolayeva, 2011). Nine months is a well-known transition period in infancy (Carpenter, Nagell, & Tomasello, 1998), so perhaps the

period right before this major shift is characterized by a radical alteration in previously stable abilities. Though this hypothesis is interesting, the data again fail to provide much in the way of assistance. It would have been surprising had 8-month-olds shown a preference for the helper as well as increased looking time when the climber approached the helper—this would have indicated a reversal of social evaluations between 7- and 9-months. Neither of these results was observed, however. Rather, 8-month-olds appeared to have formed no preferences of their own and did not expect the climbing shape to have formed any either. Furthermore, Hamlin et al. (2011) found that 8-month-olds not only formed a preference for a helping agent but that they also preferred an agent who punished a hindering agent. These results suggest that 8-month-olds are not atypical in any way. Nonetheless, it must be pointed out that Hamlin et al.'s (2011) puppet show may be simpler than the climbing task. Puppets do, after all, possess an abundance of agency clues. Even if 8-month-olds formed second-order preferences (to prefer those who hinder those they do not like) it may be that the first-order preference is somehow more difficult for them. This is at least consistent with the current experiment, and future research may benefit from exploring differences in performance starting at around 8 months.

Infants' Understanding of Other Minds

An aspect of social evaluation research that has yet to be explored in the literature is the potential implications for research on theory of mind. Hamlin et al. (2007) and Wynn's (2008) results showed that 9- and 10-month-olds seem to be capable of attributing mental states to another agent. Though the looking time task does not

require the representation of another agent's false beliefs—the *sine qua non* of theory of mind—it does require a comparison between one's own evaluations and that of another agent. Until recently, theory of mind abilities were thought to develop around the age of three (Carpenter, Call, & Tomasello, 2002; Clemens & Perner, 1994; Garnham & Ruffman, 2001; Siegal & Beattie, 1991). However, a variety of recent studies have suggested that these abilities can be seen much earlier, at least by 14 months (Onishi & Baillargeon, 2005; Surian, Caldi, & Sperber, 2007) and perhaps as young as 7 months (Kovács, Téglás & Endress, 2010). Hamlin et al.'s line of research could be seen as contributing to this re-interpretation of the development of theory of mind abilities. The results of the looking time test in the current experiment showed that 7- and 8-month-olds performed like the 6-month-olds in Hamlin et al. (2007), looking equally whether the climber approached the helper or the hinderer. Thus it can be posited that a new ability develops around 9 months of age, one that might be related to theory of mind abilities.

Two different systems have been proposed to account for recent evidence for theory of mind abilities in infancy (Baillargeon, Scott, and He, 2010; Beate, 2011; Luo & Baillargeon, 2010; Scott & Baillargeon, 2009). The first, subsystem-1 (SS1), is responsible for processing others' goals and dispositions, what other agents have seen (and thus what they can know), and generally what reality consists of for other agents (Luo and Baillargeon, 2010, p. 304). Hamlin et al.'s (2007) original climbing task has been interpreted as pertaining solely to this subsystem (Baillargeon, Scott, & He, 2010; Scott & Baillargeon, 2009). For example, Hamlin and Wynn (2011) explain the results

of the choice test from their puppet events in terms of attributing goals and subsequently making social evaluations of those goals. The ability to attribute goals and dispositions is an ability possessed by infants as young as 3-month-olds (Luo, 2010), so the social climbing task itself probably does not require anything beyond SS1 abilities.

The looking time test is what is at issue, however, and here the implications are less clear. Subsystem-2 (SS2) has been explicated primarily in relation to false belief representation, and thus is somewhat tangential to the attribution of social evaluations. SS2 is responsible for tracking whether other agents possess the same knowledge as oneself, and representing to an infant any incongruence between reality and what others believe about reality (Luo & Baillargeon, 2010). The relevant question, then, is whether the looking time task from Hamlin et al. (2007) measures the discrepancy between infants' understanding of their reality and that of the climbing agent.

In the looking time test, the infants are expected to apply what they learned from the climbing task to a new but not entirely novel task. The climber is moving across a shallow hill, but instead of climbing, it is expressing a preference for one agent over the other. There is no other obvious goal besides that of moving towards one agent instead of another. The reason why this might be thought of as eliciting SS2 is that the looking time test is essentially measuring whether the infants expect someone else's evaluations to match their own. The choice test, by contrast, measures whether infants attribute goals to the agents and subsequently form social evaluations—these are more explicitly SS1-related skills. The looking time test measures something in addition to this. Differential looking times indicate that infants are comparing their own evaluations with the apparent

evaluations of the climbing agent. If the infants hold no expectations with respect to the climbing agent, or if they have not processed the climbing task at all, then they will look equally long whether the helper or the hinderer is approached.

Consider Woodward (1998, described above), a standard depiction of the operation of SS1 in infancy. Infants in this task, and many like it, expect that an agent's expressed preference for an object in one context will generalize to all others. The obvious difference between a Woodward-type task and the looking time test of Hamlin et al. (2007) is that the climbing agent in Hamlin et al. (2007) is not expressing a preference for either agent. The tasks the climbing agent has engaged in, as far as the infants can tell, have no apparent relevance to showing a preference for anything besides reaching the top of a hill. The looking time test is essentially a new task, in which the only information relevant to the infants is 1) they (the infants) like the helper, and 2) the climbing agent is ostensibly expressing its own preference. The task, considered apart from the climbing events, consists of a similar assessment as that of Woodward-type tasks. The challenge facing the infant, however, when considering the transition from the climbing events to the looking time test, consists of a comparison between the infants' previous evaluations and the expectations they have of the climbing agent. One way of explaining performance on this task is to say that older infants show a difference in looking time because they compare their representation of reality to that of the climbing agent and see no reason why the climber's preference should diverge from theirs. Younger infants conduct no comparison because they lack theory of mind abilities, and so do not form any expectations.

An additional consideration for why performance on the looking time task should be seen as relevant to theory of mind can be gleaned from Hamlin et al. (2011). As described previously, they found an age difference between 5- and 8-month-olds on the ability to make second-order social evaluations. 8-month-olds not only preferred the helper, they also preferred those who helped the helper or hindered the hinderer. Five-month-olds, by comparison, were only capable of making the initial evaluation of helper over hinderer. Aside from making the present choice data appear abnormal, these results also suggest that 8-month-olds possess sophisticated abilities related to theory of mind. They understand not only that something can be good or bad, but also that others will evaluate agents as good or bad. The ability to make these attributions to other agents furthermore entails the expectation that others will treat good and bad agents in certain ways.

Both 5- and 8-month-olds are well within the proposed time range for SS1, so it's odd to see such a striking age-difference in ability in these experiments. This leaves two possibilities: 1) 8-month-olds have simply acquired more social knowledge than 5-month-olds, or 2) they have acquired abilities pertaining to theory of mind, consistent with other studies showing that these abilities develop around 7 months of age. 8-month-olds in the current experiment of course failed to show a preference for the helper, which suggests that they would be unable to form a second-order preference as the 8-month-olds in Hamlin et al. (2011) did. Though this is puzzling, for the sake of analysis the more pertinent question is whether the 9-month-olds' performance on the looking time task from Hamlin et al. (2007) and the 8-month-olds in Hamlin et al. (2011) should be

considered a result of increased social knowledge or newly developed theory of mind abilities.

The social knowledge hypothesis has some plausibility. That there is a specifically *social* domain that arises early in development was first proposed in the late 1970s and early 1980s (Smetana, 1981, 1984; Turiel, 1977, 1978, 1983; recent extensions of this include Bugental, 2000 and Grusec & Davidov, 2010). More recently, it has been proposed that social knowledge arises sufficiently early in development and provides a foundation for so many other abilities that it should be considered a “core knowledge system,” on par with knowledge of objects, actions, number, and space (Spelke, 1990; Carey & Spelke, 1994; Spelke & Kinzler, 2007). To extrapolate, just as knowledge about the solidity and cohesion of objects is central to physical reasoning (Baillargeon & Carey, in press), perhaps an understanding of action valence (good or bad) and preference formation is central to social evaluation. This would lend priority to a social knowledge explanation for performance on the looking time test, as core knowledge systems are thought to be largely innate, and would thus be available prior to the development of theory of mind abilities.

Although the social knowledge hypothesis helps explain the early development of social evaluations, it doesn't appear to be able to account for the age-difference in Hamlin et al.'s (2007) looking time test. As argued above, the looking time test seems to require additional *mental* abilities. Proposed features of an early developing core system of social knowledge have been limited primarily to the ability to recognize members of one's social group (Spelke & Kinzler, 2007). We might add to this the ability to attribute

goals, dispositions, and to act prosocially. However, none of these skills account for the ability to attribute preferences to other agents, and to compare these preferences to one's own. Assuming that it is true that social knowledge develops early in infancy, it appears that this ability remains relatively stable up until 8 or 9 months of age, and then is supplemented by newly developed theory of mind abilities. This is what contributes to the production of the types of attributions shown in the looking time test.

Conclusion

One key result from this experiment was that the 7- and 8-month-olds performed more like the 6-month-olds than the 10-month-olds in Hamlin et al.'s (2007) looking time test. Other questions were raised by the choice test results, but these looking time data do assist in resolving the initial question of what develops after 6 months. The considerations of this last section further suggest that future investigations of social evaluation in infancy might benefit from pitting hypotheses related to social knowledge against hypotheses related to theory of mind. If theory of mind abilities originate around 7 months, it may be theory of mind mechanisms, and not social knowledge, that require further illumination.

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